Guideline for Monitoring and Management of Soil Contamination Under EPEA Approvals

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Chemicals Assessment and Management Division
Environmental Regulatory Service

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Additional copies may be obtained by contacting:

Information Centre
Alberta Environment
Main Floor, Great West Life Building
9920 –108 Street
Edmonton, Alberta T5K 2M4
Phone: (780) 944-0313
Fax: (780) 427-4407

A. Introduction

Soil monitoring is required as an Environmental Protection and Enhancement Act (EPEA) approval condition at facilities where substances may be released to soil. Where the risk of soil contamination is minimal because of the kind of operation, or because engineered controls are in place to protect soil, all or part of the facility may be exempted from soil monitoring requirements.

The main objective of soil monitoring is to prevent and mitigate contamination by substances with the potential to exert an adverse effect on the soil itself, and on air, water and organisms that may contact the soil. As such, soil monitoring targets only certain types of substances. Contaminants of concern that indicate a need for soil monitoring will have one or more of the following properties:

- are toxic (such as heavy metals, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons);
- are mobile in soil with the potential to damage groundwater quality (such as monoaromatics, amines, and some salts); and
- exert adverse effects on soil properties (such as sodium salts, high levels of low-toxicity hydrocarbons, and elemental sulphur).

Soil monitoring, within the approvals program, is directed primarily to the assessment of contaminants that have been released to the soil surface. Thus, subsurface facilities are generally not the reason for soil monitoring, but may be the reason for groundwater monitoring. However, where soil contamination is known or suspected to originate from subsurface sources such as underground tanks or pipes, an assessment will be required.

Where the above considerations indicate soil monitoring is required as a condition of an Approval, the proponent is required to carry out the following, as specified in the Soil Monitoring Directive:

- prepare a soil monitoring proposal;
- execute the approved soil monitoring plan;
- interpret and report the results of the soil monitoring; and
- prepare and execute a soil management plan where indicated by the results of soil monitoring.

This guideline provides a background for the soil monitoring program and a description of soil management program requirements.

B. Legislative Background

The soil monitoring program was developed under section 14(4) of the Environmental Protection and Enhancement Act in support of the following principles:

- development must be sustainable, meaning that the use of resources and the environment today must not impair prospects for their use by future generations (s. 2c);
- the environmental impact of development must be prevented or mitigated (s. 2d);
- polluters should bear the responsibility of paying for the costs of their actions (s.2i);
- remediation costs should be incorporated into financial planning so that adequate funds are available for site remediation and planners can know the true costs and benefits of source reduction programs (s. 2b).

Consistent with the above principles, the Act specifically addresses the release of substances through certain prohibitions and requirements including:

- Duty to identify and eliminate sources of contaminant release (s. 97);
- Duty to report the release of substances into the environment (s. 99);
- Duty to identify and remediate contamination before environmental media or potential receptors are affected (s. 101);
- Designation of a contaminated site (s. 110) with attendant powers given to the Director (s. 114) when contaminants have caused, are causing, or may cause a significant adverse effect.

Recognizing that under the Act, environmental protection is a shared responsibility (s. 2f), it follows that both the approval holder and the Department must have a means to assess environmental performance with respect to the above principles and requirements. Soil monitoring is the tool by which environmental performance relative to soil quality is to be assessed and managed.

C. Soil Quality Standards

Alberta Environmental Protection expects that approval holders will manage their operations to prevent substance releases to soil. Substance releases to soil do occur, however, and contaminants are often present above background concentrations at industrial facilities. In view of this, Alberta Environmental Protection has established soil quality standards to guide assessment and remediation of soil contamination. Alberta Tier I criteria (AEP 1994a) were developed to protect against adverse effects regardless of land use. CCME Canadian Environmental Quality Criteria for industrial sites (CCME 1991) were developed to provide a similar level of protection under industrial land use at sites where soil contamination has already occurred.

Facilities that are currently uncontaminated have the opportunity to maintain conditions that allow unrestricted land-use. For these facilities, the minimum standards will be determined by the Alberta Tier I criteria or equivalent objectives. Older facilities, however, were often operated under different standards and environmental management practices than are currently acceptable. Past practices may have left a legacy of soil contamination at these facilities. In such instances, the CCME industrial criteria or equivalent objectives may be accepted as minimum standards while the facility is operating.

Some restrictions apply to the use of the above mentioned soil quality standards. Contamination of a currently uncontaminated area up to CCME industrial levels is not acceptable. Therefore, CCME industrial criteria will only be accepted for those areas known to be contaminated above Alberta Tier I criteria by historic releases. Use of both Alberta Tier I criteria and CCME industrial criteria is also subject to site suitability criteria, as described in the Soil Monitoring Directive (Section C.1). Where the ambient background concentration of a given substance exceeds the applicable soil quality standard, the standard can be set equal to the ambient background concentration.

D. Soil Management Program Requirements

D.1 Approval Requirements

If soil contaminants are found at concentrations that exceed the applicable standards specified in the approval, the approval holder is required to implement a soil management program and provide periodic progress reports to the Director of Air and Water Approvals. This program must be accepted by the Director.

The program must first address source control to stop on-going contaminant releases. After the sources of contamination have been stopped, further assessment and delineation of the contaminated area may be necessary. When the extent of contamination is understood, remediation objectives, as described below, must be adopted for the area. These objectives are to be submitted for review and written authorization by the Director. Once remediation objectives have been agreed to, appropriate treatment or containment technologies can be chosen and the management plan finalized.

D.2 Remediation Objectives

D.2.1 Background Principles

As a participant in the Canadian Council of Ministers of the Environment, Alberta Environmental Protection advocates remediation of contamination to the lowest level possible (CCME 1991). Under the Environmental Protection and Enhancement Act, the Province's primary regulatory goal for site remediation is the restoration of equivalent land capability. Equivalent land capability means that the capability of the land to support various land uses has not been materially degraded by a particular use. In terms of chemical contaminants, the

Department considers that equivalent land capability is protected when Alberta Tier I (AEP 1994a) or equivalent objectives have been met. Failure to achieve equivalent land capability restricts land-use options.

D.2.2 Developing Remediation Objectives

Remediation objectives may be developed in a variety of ways ranging from generic guidelines to site-specific risk assessment (CCME 1996a).

Generic guidelines are numerical concentration limits that are applicable under a variety of site conditions. Examples of generic guidelines are the Alberta Tier I Criteria (AEP 1994a) and the CCME interim commercial/industrial criteria (CCME 1991). The Alberta Tier I criteria are intended to be protective of *all* potential land uses; the CCME criteria support a *particular* land use.

When neither Alberta Environmental Protection nor the CCME has a guideline for a particular substance, four options are available. First, the remediation objective may be based on the ambient background concentration for the site as described in AEP (1995). Second, the CCME guideline development protocol (CCME 1996b) may be applied. This method allows for some adaptation to site-specific conditions as described in CCME (1996a). Third, a remediation objective may be adopted from another jurisdiction if the proponent can show that the remediation objective is consistent with the environmental protection goals of the approval. Finally, a remediation objective may be developed by the proponent using site-specific risk assessment procedures. A risk assessment for an approved facility will focus on human health concerns but fundamental ecological concerns must also be addressed.

Site-specific risk assessment is a means of quantifying the likelihood that soil contamination will have a harmful effect under conditions found at a specific site. The essential components of human health and ecological risk assessments are similar, however, ecological risk assessments tend to be more complex than those for human health because a wide variety of receptors may have to be considered. Very briefly, a site-specific risk assessment may be described as consisting of the following steps or components (Figure 1):

Problem formulation involves developing a conceptual model of the possible contaminant effects on receptors at the site. The conceptual model describes contaminant distribution and concentration in relation to the receptors and their patterns of activity on the site.

The *exposure assessment* describes the pathways by which soil contaminants may be taken up by the receptor. This information is combined with receptor characteristics in order to estimate the contaminant uptake.

The *toxicity assessment* describes the adverse effects that the contaminants may cause and the dose at which these effects occur.

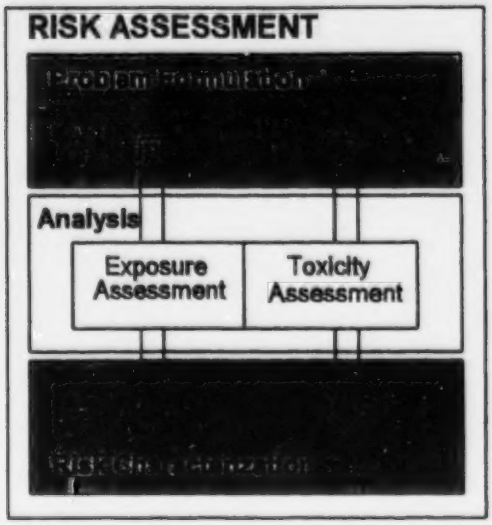

Figure 1. Risk Assessment Framework

The final step, *risk characterization*, compares this dose with the uptake rate (estimated during the exposure assessment) and determines whether or not an adverse effect is likely to occur.

Risk assessment procedures can also be used to back calculate a contaminant concentration in soil at which no adverse effects are expected. Interaction with Alberta Environmental Protection is important at all stages of the risk assessment. More detailed guidance is available from the Canadian Council of Ministers of the Environment (CCME 1996c), United States Environmental Protection Agency (U.S. EPA 1991), and the Agency for Toxic Substances and Disease Registry (ATSDR 1992).

At times, it may not be possible to remediate to a level compatible with industrial land-use objectives. In such cases, the approval holder must ensure that the contaminants are contained and receptor exposure does not occur. Formal risk assessment procedures are necessary to meet these requirements. Typically, an engineered containment system is required, the performance of which must be confirmed through periodic inspections and monitoring. The approval holder bears responsibility for the design, construction, assessment and maintenance of the risk management system, and any necessary emergency response should the system fail.

E. Enforcement Policy

Alberta Environmental Protection expects that all approval holders will comply with the terms and conditions of their approval. When points of disagreement arise between the approval holder and Alberta Environmental Protection they are discussed prior to issuing an approval and resolved in a cooperative fashion. However, the Department recognizes that enforcement may

sometimes be necessary to ensure compliance. Alberta Environmental Protection is committed to firm but fair enforcement of environmental legislation in a timely and consistent manner.

Enforcement is generally the last step in a regulatory process that aims to first prevent potential problems before they arise and to resolve existing problems in a cooperative manner. When discussions between the approval holder and the Department fail to prevent or resolve a contravention of an approval or the Act, a number of abatement and enforcement tools are available to the Department including:

- environmental protection orders;
- warning letters;
- tickets;
- administrative penalties;
- enforcement orders;
- prosecutions;
- court orders; and
- cancellation of approvals or certificates.

The Department's enforcement policy is discussed in AEP (1993, 1994b).

F. References

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